Entrepreneurship as a Strategic Option for Achieving Food Security

A Review of Global Experiences

Ahmed Necib *

University of Algiers 3, Algeria

ahmednecib79@gmail.com

Mohammed laid Amamra

University of El Oued - Algeria

amamra-mohammedelid@univ-eloued.dz

Received:**14/02/2026** Accepted: 21/04/2026 Published: 31/05/2026

Abstract:

In response to growing global threats to food security, including climate change, supply chain disruptions, rapid population growth, and the depletion of natural resources, entrepreneurship has emerged as a strategic approach to addressing these challenges. This study adopts a qualitative comparative analytical framework to examine the role of entrepreneurship in enhancing sustainable food security through selected international experiences, namely the Netherlands, Singapore, Canada, and the United Arab Emirates. These cases were selected based on criteria of geographical diversity, technological leadership, policy effectiveness, and data availability from reliable international sources such as FAO and the World Bank.

The study relies on secondary data analysis and employs a comparative approach structured around the four dimensions of food security: availability, access, utilization, and stability. It further identifies key success factors, implementation challenges, and transferable lessons for developing countries.

The findings indicate that entrepreneurial initiatives in agriculture and food systems, supported by advanced digital technologies and enabling policy frameworks, significantly enhance food production, improve quality, strengthen supply chains, and increase system resilie.

Keywords: Entrepreneurship, Food Security, Smart Agriculture, Innovation, Sustainable Development.

Jel Classification Codes : Q13, Q18, O31, L26.

*Corresponding author

1. Introduction :

Food security represents one of the most pressing strategic challenges confronting the international community in the twenty-first century, especially amid rapid population expansion, natural resource depletion, intensifying climate change effects, and instability across global supply chains. Securing sustainable food access has thus become an issue that goes beyond agriculture alone, intersecting with wider concerns involving economics, technology, and international governance.

In this context, entrepreneurship has emerged as a strategic pathway capable of driving a qualitative transformation in food systems by stimulating innovation, raising production efficiency, and developing new business models that are more resilient and sustainable. Many global experiences, particularly in Europe, Asia, and Africa, have effectively leveraged entrepreneurial initiatives to reinforce agricultural value chains and integrate modern technologies such as smart farming, artificial intelligence, and renewable energy to support food security. (Shahbaz et al., 2023, p. 4).

Research Problem:

Given the growing global food crises and the declining capacity of traditional systems to respond effectively to emerging challenges, the central research problem of this study is articulated through the following question:

How can entrepreneurship be leveraged as a strategic option to achieve food security, and what lessons can be drawn from successful international experiences in this field?

This main question gives rise to several sub-questions:

What is the relationship between entrepreneurship and food security in the global context?

What are the most prominent international experiences that have successfully integrated entrepreneurial initiatives into food policies?

How can developing countries benefit from these experiences to strengthen their own food security?

Significance of the Study:

The significance of this study lies in highlighting the role of entrepreneurship in addressing the issue of food security from a developmental and strategic perspective, particularly amid rapid economic and technological transformations. It is especially relevant for developing countries, which are increasingly seeking innovative and sustainable solutions to reduce food dependency and enhance their productive sovereignty.

Objectives of the Study :

- To analyze the theoretical framework of the relationship between entrepreneurship and food security.

- To review the most prominent global pioneering experiences in this field and identify the key factors behind their success.
- To derive lessons and policy implications that can be employed to support food security in developing countries.

Methodology:

This study adopts a qualitative comparative analytical approach to examine the role of entrepreneurship in achieving food security through selected international experiences. It relies on a structured review and comparative analysis of secondary data from reliable sources such as FAO and the World Bank.

The case studies (the Netherlands, Singapore, Canada, and the UAE) were selected based on criteria including geographical diversity, technological leadership, policy effectiveness, and data availability. Data collection was conducted through systematic document analysis and keyword-based searches.

The analysis follows a comparative framework focused on identifying patterns and lessons, based on the four dimensions of food security: availability, access, utilization, and stability.

2. Entrepreneurship and Food Security – Concept and Relationship

2.1. The Concept of Entrepreneurship and Food Security

Entrepreneurship is considered one of the central concepts in modern economics, as it represents a driving force behind innovation, value creation, and the achievement of sustainable development. (Peter Drucker ,1985, p. 32) defines entrepreneurship as the ability to seize opportunities through innovation and the mobilization of resources in ways that generate sustainable economic and social outcomes. World Bank literature also indicates that entrepreneurship has become a strategic engine for transforming traditional agricultural economies into productive systems based on knowledge and technology (World Bank, 2024, p. 6).

On the other hand, food security is a comprehensive concept that goes beyond the mere availability of food to include the ability to access and consume it in a safe and nutritious manner. According to the definition of the Food and Agriculture Organization of the United Nations (FAO, 2022, p. 15), food security is achieved when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Food security is built upon four main dimensions:

- Food Availability (Availability): the existence of adequate quantities of food produced locally or imported.

- Food Access (Accessibility): the ability of individuals to obtain food economically and geographically.
- Food Utilization (Utilization): ensuring food quality in terms of nutritional value and health safety.
- Stability (Stability): the sustainability of these dimensions over time, without disruption due to crises or climate changes (FAO, 2023, p. 12).

2.2. The Relationship Between Entrepreneurship and Food Security:

The relationship between entrepreneurship and food security is evident in the fact that entrepreneurship represents a vital mechanism for enhancing the efficiency and sustainability of food systems. Entrepreneurship provides the institutional and economic framework through which innovative ideas can be transformed into practical solutions that contribute to addressing food-related challenges.

2.2.1. Enhancing Agricultural Production :

Entrepreneurship plays a crucial role in enhancing agricultural production by introducing and integrating technological innovations into farming and production processes. Through entrepreneurial initiatives, farmers and agribusinesses can adopt precision agriculture techniques that optimize the use of inputs such as water, fertilizers, and pesticides, thereby increasing efficiency and reducing costs. The application of artificial intelligence in crop management enables real-time monitoring of plant health, prediction of pest and disease outbreaks, and precise decision-making to maximize yields. Furthermore, climate data analytics allows producers to anticipate and mitigate the risks associated with extreme weather events, shifting rainfall patterns, and temperature fluctuations, contributing to more resilient agricultural systems. By combining these advanced technologies with innovative business models, entrepreneurship not only improves productivity but also ensures the sustainability and long-term competitiveness of the agricultural sector (FAO, 2023, p. 18). These technologies increase production efficiency and reduce water consumption, thereby positively influencing food security.

2.2.3. Improving the Efficiency of Food Supply Chains:

Entrepreneurial ventures enhance the efficiency of food supply chains through digitalization and the use of electronic platforms to coordinate transportation, storage, and distribution operations. This contributes to reducing food loss and waste by an estimated 20% to 40% in certain experimental models (World Bank, 2024, p. 11).

2.4. Creating Employment Opportunities:

Entrepreneurship also contributes to the creation of new job opportunities, particularly in rural and agricultural areas, by encouraging young people to invest in projects related to agro-processing, e-marketing, and food logistics services (Betka & Mordjane, 2024, p. 22).

This entrepreneurial economic role helps reduce rural poverty and improve income levels, which represents

a fundamental pillar in achieving sustainable food security.

3. Leading Global Experiences in Entrepreneurship for Achieving Food Security

3.1. The Netherlands Leadership in Smart Agriculture:

The Netherlands represents a distinguished global model in smart agriculture and agripreneurship. Despite its limited land area, the country has successfully built a **high-value agricultural export sector**, becoming the world's second-largest exporter of agricultural products by value, after the United States. In 2023, Dutch agricultural exports were valued at **€123.8 billion**, rising to **€128.9 billion in 2024**, and further reaching **€137.5 billion in 2025**, reflecting a steady growth of approximately **4.8% from 2023 to 2024** and **8.4% from 2024 to 2025** (FAO, 2023, p. 44). This achievement is largely attributed to the adoption of an integrated economic model that combines scientific research, technological innovation, and entrepreneurship within the agricultural sector.

Since the early 2000s, Dutch agricultural policy has strongly focused on the concept of precision agriculture, which is based on the use of advanced digital technologies such as artificial intelligence (AI), drones, and sensor systems to monitor crops. This approach has enabled a reduction in water consumption by up to 30% and improved fertilizer efficiency (Klerkx & Villalobos, 2024, p. 3).

Entrepreneurial companies such as Koppert Biological Systems and PlantLab are among the most prominent examples that embody agricultural innovation in the Netherlands. Koppert develops biological alternatives to chemical pesticides by using beneficial microorganisms for pest control, while PlantLab specializes in vertical farming systems inside fully automated greenhouses, allowing continuous production without reliance on traditional climatic conditions (World Bank, 2024, p. 14). In addition, Wageningen University, one of the world's leading agricultural universities, plays a central role in this model by launching business incubators and training programs for agripreneurship, and by directing scientific research toward practical applications that contribute to global food security (FAO, 2023, p. 46).

The key lesson from the Dutch experience is that achieving food security does not depend solely on the availability of natural resources or production capacity, but rather on integrating science with entrepreneurship within an innovative ecosystem that supports collaboration among universities, start-ups, and the public sector. The Dutch model confirms that structured and institutionally supported innovation is fundamental to building sustainable food systems capable of confronting future environmental and economic challenges (Klerkx & Villalobos, 2024, p. 5).

3.2. Singapore Urban Agriculture and Technological Entrepreneurship:

Singapore is among the leading countries that have faced a severe challenge in achieving food security due to its limited agricultural land and small geographical area. It imports more than 90% of its food needs from

abroad (World Bank, 2022, p. 78). With the increasing risks associated with fluctuations in global markets and supply chains, the Singaporean government recognized the urgent need to develop a local food production model based on innovation and entrepreneurship.

To achieve this goal, Singapore launched its national strategy in 2019, known as "30 by 30", which aims to produce 30% of its food needs locally by 2030 through investment in smart farming, biotechnology, and vertical agriculture (FAO, 2023, p. 52).

Within this framework, pioneering entrepreneurial projects emerged that redefined the concept of urban farming, most notably:

- Sky Greens, which developed the world's first commercial low-energy vertical farming system, based on rotating structures that utilize gravity and hydraulic energy to reduce electricity and water consumption by more than 40% compared to traditional agriculture (World Bank, 2024, p. 17).
- Sustenir Agriculture, which relies on hydroponics technology to produce high-quality vegetables in a closed, contaminant-free environment, enabling stable year-round production without the need for agricultural soil (Klerkx & Villalobos, 2024, p. 6).

What distinguishes the Singaporean experience is the integration of entrepreneurship with technology and smart governance. The government provided a flexible regulatory environment and supported entrepreneurs through financial incentives and the funding of agricultural innovation through sovereign-backed mechanisms (FAO, 2023, p. 53). Universities and research centers, such as Nanyang Technological University, have also contributed to developing digital agricultural solutions using artificial intelligence to monitor food production and analyze environmental data.

As a result of these policies, Singapore has transformed into a global laboratory for urban agriculture, combining advanced technology with sustainable entrepreneurship. It offers a model for resource-limited countries on how food security can be achieved through innovation and effective resource management. The Singaporean experience demonstrates that food security is not achieved through abundant resources, but through abundant entrepreneurial ideas and the ability to harness technology in service of people and the environment (World Bank, 2022, p. 80).

3.3. Canada Entrepreneurship in Sustainable Food Industries:

Canada is considered one of the leading countries in sustainable agricultural and food entrepreneurship, as it has adopted a comprehensive governmental approach to supporting innovation and technology across food value chains. Under the Sustainable Canadian Agricultural Partnership (Sustainable CAP), the federal, provincial, and territorial governments are investing a total of CAD 3.5 billion over five years (2023–2028) to strengthen competitiveness, innovation, and resiliency in the agriculture and agri-food sector. This

overarching framework includes key programs such as AgriInnovate, AgriScience, AgriMarketing, and others designed to accelerate technological adoption and sustainability (Government of Canada, 2023, p. 56).

These programs aim to encourage young entrepreneurs to develop innovative food solutions by providing financial incentives, technical guidance, and partnerships with universities and agricultural research centers. Between 2020 and 2024, more than 1,200 projects received funding through initiatives such as AgriInnovate and AgriScience, with individual grants ranging from CAD 50,000 to CAD 5 million. These projects target innovations in sustainable agriculture, alternative proteins, smart farming, and low-carbon technologies.

In addition to funding, the programs facilitate collaboration with universities such as the University of Guelph and McGill University, and research centers across Canada, allowing start-ups to access state-of-the-art laboratories, technical mentorship, and pilot testing platforms. This integrated support has helped create a vibrant entrepreneurial ecosystem that fosters innovation, enhances domestic food production, and reduces dependence on imports. As a result, domestic production of plant-based protein alternatives increased by 35% between 2021 and 2024, contributing significantly to economic growth and national food resilience (FAO, 2023, p. 61).

Among the most notable start-ups that benefited from these policies are:

- Beyond Meat Canada, which is one of the leading companies developing plant-based meat alternatives using proteins extracted from plants, with the goal of reducing environmental impact and promoting healthy nutrition (Shahbaz et al., 2023, p. 5).
- Good Food Market, which relies on digital solutions in food distribution management through smart applications that enable consumers to plan meals and order fresh products online, contributing to **the** reduction of food waste and improving supply chain efficiency (World Bank, 2022, p. 83).

The Canadian experience has shown that entrepreneurship is not merely an economic activity, but rather a driver for sustainable food security through innovation and technology. Government support for start-ups has increased the diversity of local products and accelerated the development of sustainable food alternatives that meet public health requirements and environmental protection goals.

3.4. The United Arab Emirates – Entrepreneurship in Agriculture within Arid Environments:

The United Arab Emirates is one of the leading Arab countries that has embraced agricultural entrepreneurship as a strategic approach to address environmental and climate challenges, particularly water scarcity, high temperatures, and limited arable land. In 2021, the UAE government launched the Food Tech Valley initiative, an ambitious national project designed to integrate advanced technologies with entrepreneurial solutions to enhance food security. The initiative covers an area of approximately 1,200 hectares in the Al Ain region and represents a multi-billion-dollar investment aimed at developing innovative agricultural practices suitable for

arid environments.

Food Tech Valley focuses on promoting high-tech farming methods such as hydroponics, aeroponics, vertical farming, and climate-controlled greenhouses. By 2024, the initiative had supported over **50 start-ups** and small-to-medium enterprises (SMEs) in the agri-food sector, providing total funding exceeding **AED 500 million**. These start-ups are developing solutions to reduce water consumption by up to **90%** compared to traditional agriculture, improve crop yields, and enable year-round production of vegetables and fruits.

In addition, the initiative fosters strong collaboration between entrepreneurs, universities, and research institutions, including Khalifa University and the International Center for Biosaline Agriculture (ICBA), providing access to laboratories, technical expertise, and pilot testing facilities. The program has also attracted foreign investments, amounting to approximately USD 200 million by 2024, positioning the UAE as a regional hub for agri-tech innovation. This integrated ecosystem not only strengthens national food security but also serves as a model for other countries with harsh climatic conditions, demonstrating that entrepreneurship combined with advanced technology can effectively mitigate resource limitations and climate risks.
(UAE Ministry of Climate Change and Environment, 2024, p. 22).

The initiative focuses on enhancing agricultural research and development through cooperation between start-ups, universities, and investors to develop innovative solutions in sustainable agriculture and food production in arid environments. This project represents an advanced model in the region, serving as a national platform for supporting agricultural innovation and smart farming technologies (FAO, 2023, p. 48).
One of the most successful entrepreneurial projects within this framework is Pure Harvest Smart Farms, which is among the first companies to use climate-control technologies and hydroponics to produce fruits and vegetables inside smart greenhouses in the heart of the desert. The company relies on artificial intelligence to regulate temperature, humidity, and lighting, enabling year-round production while consuming 90% less water compared to traditional agriculture (World Bank, 2022, p. 80).

These entrepreneurial experiences have contributed to transforming the UAE into a regional hub for agricultural entrepreneurship, attracting foreign investment in agri-food technology and strengthening its position in achieving national and regional food security. Moreover, these initiatives have helped build an integrated innovation ecosystem that includes education, scientific research, and start-ups, within the framework of the UAE Vision 2051 for environmental and food sustainability (UAE Ministry of Climate Change and Environment, 2024, p. 25).

The main lesson from the UAE experience is that achieving food security in arid environments is possible through leveraging entrepreneurship and technology, supported by strong governmental and investment backing making the UAE a model for countries with limited natural resources.

3.5. Comparative Analysis of Entrepreneurial Solutions and Food Security Dimensions:

To enhance the analytical depth of the study and move beyond descriptive country experiences, a comparative framework is adopted to systematically examine how entrepreneurial solutions contribute to the different dimensions of food security. The following table presents a structured comparison between selected international experiences by mapping key entrepreneurial innovations against the four core dimensions of food security: availability, access, utilization, and stability. This approach allows for a clearer understanding of the similarities and differences across countries, as well as the identification of transferable insights.

Table 01 illustrates a comparative analysis of entrepreneurial solutions and the dimensions of food security.

Country	Entrepreneurial Solution	Availability	Access	Utilization	Stability
Netherlands	Precision agriculture, AI, smart greenhouses	Increased productivity	Lower costs	Improved quality	Long-term sustainability
Singapore	Vertical farming, hydroponics	Urban production	Reduced import dependence	Safe food production	Stable year-round supply
Canada	Alternative proteins, agri-food innovation	Diversified production	Digital distribution	Healthy food alternatives	Resilient food systems
UAE	Hydroponics, climate-controlled farming	Local production in desert	Improved supply chains	High-quality crops	Climate resilience

Prepared by the researcher based on the above-mentioned studies.

The table presents a comparative overview of four international experiences that leverage entrepreneurship to enhance the dimensions of food security. The Netherlands demonstrates a model based on smart agriculture and advanced technologies, leading to increased productivity, reduced costs, and long-term sustainability. Singapore, on the other hand, relies on vertical farming and hydroponics to overcome resource limitations, thereby strengthening local production and ensuring a stable food supply. Canada focuses on innovation in food industries and alternative proteins, contributing to diversified production, improved food quality, and greater system resilience. Meanwhile, the United Arab Emirates adopts agricultural technologies adapted to arid environments, enabling local production, high-quality crops, and enhanced climate resilience.

Overall, the table shows that entrepreneurial solutions vary according to context, yet collectively support the different dimensions of food security.

4. Success Factors of Global Experiences in Entrepreneurship for Achieving Food Security:

The global experiences of the Netherlands, Singapore, Canada, and the United Arab Emirates demonstrate that the success of entrepreneurship in strengthening food security was not coincidental. Rather, it resulted from the availability of a set of strategic and integrated factors that created a favorable environment for agricultural and food innovation (FAO, 2023, p. 52). The most prominent of these factors include:

- Investment in research and development and linking universities with entrepreneurs: Connecting academic knowledge with entrepreneurship represents one of the most important drivers of food innovation. Research institutions such as Wageningen University in the Netherlands and the National University of Singapore have played a pivotal role in supporting start-ups with scientific knowledge and applied technologies (World Bank, 2022, p. 85). This collaboration has contributed to the development of precision agricultural solutions and more efficient and sustainable production practices.
- Government support and incentive policies for financing entrepreneurial projects: Global experiences show that the presence of supportive policies for agricultural entrepreneurship such as tax exemptions, low-interest loans, and innovative funding programs is a fundamental factor in the success of such projects. Canada is a strong model in this regard through programs such as AgriInnovate and Sustainable Food Systems, which have contributed significantly to financing national food innovation (Government of Canada, 2023, p. 57).
- Adoption of modern technologies such as artificial intelligence, the Internet of Things, and drones: Advanced technology represents the backbone of modern agricultural entrepreneurship. In the Netherlands and the UAE, for example, drones and smart sensors are used to monitor crops, analyze soil conditions, and optimize resource use, which has increased productivity and reduced costs (UAE Ministry of Climate Change and Environment, 2024, p. 24).
- Encouraging youth innovation through incubators and accelerators:
  Agricultural incubators have provided an enabling environment for entrepreneurial ideas, where young innovators receive guidance, funding, and training. These initiatives have contributed to the emergence of innovative companies such as Sky Greens in Singapore and Pure Harvest Smart Farms in the UAE, both of which developed practical solutions for sustainable agriculture (Shahbaz et al., 2023, p. 6).
- Environmental sustainability as a core condition in agricultural and food projects: Sustainability has become a cornerstone of all successful experiences. Entrepreneurship is no longer solely aimed at profit generation, but also at reducing environmental impact and protecting natural

resources for future generations. The Dutch experience is a pioneering example of integrating smart agriculture with the green economy, making it a global model for sustainable food security (FAO, 2023, p. 54).

5. Challenges Facing Food Entrepreneurship:

Despite the successes achieved by many countries in developing entrepreneurial projects that enhance food security, this path faces a range of structural, technical, and financial challenges that may hinder the sustainability of innovation in the agricultural and food sectors (FAO, 2023, p. 60). The most notable challenges include:

- Limited early-stage financing:

  Most entrepreneurial projects in the food and agriculture sector suffer from a lack of initial funding, especially in developing countries. High risks and weak investment guarantees reduce the willingness of banks and investors to finance such initiatives (World Bank, 2022, p. 89). Moreover, the long agricultural production cycle means that financial returns are not immediate, which further increases the difficulty of attracting venture capital.

- Weak digital infrastructure in some developing countries:

  The success of modern food entrepreneurship depends heavily on digital infrastructure such as high-speed internet, open data, and smart tracking systems. However, many developing countries still lack these requirements, limiting their ability to implement smart agriculture or food e-commerce (Shahbaz et al., 2023, p. 8).

- Resistance to change in traditional agricultural systems:

  Entrepreneurs in the agricultural sector face a cultural challenge represented by the resistance of traditional farmers to modern technology, due to fear of risks or a lack of technical knowledge. Overcoming this barrier requires continuous training and extension programs to integrate farmers into food innovation ecosystems (FAO, 2023, p. 62).

- High costs of modern technology:

  The high cost of agricultural technologies such as smart irrigation systems, sensors, and drones represents one of the most significant obstacles to scaling up food entrepreneurship projects, particularly for small and medium entrepreneurs (UAE Ministry of Climate Change and Environment, 2024, p. 27). The lack of local manufacturing of such technologies also increases reliance on imports, raising the overall cost of projects.

Overcoming these challenges requires supportive government policies, international partnerships in research and development, and accessible financing for start-ups in the food and sustainable agriculture

sectors, in order to ensure a balance between innovation and economic feasibility (Government of Canada, 2023, p. 61).

6. Lessons Learned from Global Experiences in Achieving Food Security through Entrepreneurship:

Recent international experiences demonstrate that entrepreneurship has evolved far beyond being a mere profit-driven activity. It has become a vital strategic approach for achieving sustainable food security, capable of transforming the way food systems operate. In today's complex global environment, where challenges such as climate change, population growth, and resource scarcity threaten the stability of food supply, entrepreneurial initiatives provide innovative solutions that enhance the resilience and efficiency of agricultural and food production systems.

Countries that have embraced entrepreneurship and innovation within the agricultural and food sectors have witnessed significant improvements in productivity, not only through the adoption of new technologies but also by optimizing traditional farming practices and supply chain management. These approaches have led to a reduction in food loss and waste, ensuring that available resources are used more effectively while improving the quality and nutritional value of food products.

Moreover, entrepreneurship contributes to the development of environmentally and socially sustainable food systems. It encourages the use of renewable energy, smart irrigation techniques, and precision agriculture, which minimize environmental impact while supporting long-term ecological balance. At the same time, entrepreneurial projects often foster community engagement, generate employment opportunities, and promote social inclusion, particularly in rural areas.

Ultimately, these experiences illustrate that integrating innovation and entrepreneurship into food systems is not merely an economic imperative; it represents a comprehensive strategy to secure food availability, accessibility, and sustainability for present and future generations. By prioritizing creativity, knowledge application, and adaptive management, countries can build food systems that are resilient, equitable, and capable of addressing the multifaceted challenges of the twenty-first century
(FAO, 2023, p. 65).

Modern technologies such as smart agriculture, urban farming, and agricultural biotechnology are no longer viewed as simple technical tools. Instead, they have evolved into integrated economic systems that reshape food value chains by combining scientific creativity with entrepreneurial management (World Bank, 2022, p. 91). The experiences of the Netherlands, Singapore, and the UAE represent leading models that demonstrate how entrepreneurial projects can drive structural transformation in the food sector through innovation and technology.

However, transferring these experiences to developing countries requires the preparation of an attractive

institutional and legislative environment, the provision of sustainable financing mechanisms for start-ups, and the promotion of a societal culture supportive of agricultural innovation.

Building a knowledge-based food economy cannot be achieved without investing in human capital, entrepreneurial education, and the development of competencies capable of leading smart agricultural transformation.

Accordingly, it can be argued that achieving future food security is closely linked to the ability of countries to adopt entrepreneurship as a mindset and approach that integrates scientific research, smart management, and green technology within a strategic vision that places food as a national priority for sustainable development (Government of Canada, 2023, p. 64).

However, despite the success of these global models, their direct replication in developing countries remains constrained by several structural limitations, including limited financial resources, weak digital infrastructure, and institutional inefficiencies.

To overcome these barriers, developing countries can adopt adaptive strategies, such as:

- Promoting low-cost innovations (e.g., small-scale hydroponics instead of large vertical farms);
- Encouraging institutional reforms that simplify investment procedures and support start-ups;
- Developing collaborative innovation ecosystems involving universities, local entrepreneurs, and public institutions;
- Leveraging international partnerships to transfer knowledge rather than expensive technologies.

This approach allows resource-constrained countries to bypass high technological costs while still benefiting from entrepreneurial solutions tailored to their local context.

7.Conclusion:

Global experiences clearly demonstrate that entrepreneurship has become a fundamental pillar in achieving sustainable food security. Modern technologies such as smart agriculture, urban farming, and biotechnology are no longer merely technological tools; they have evolved into integrated economic and managerial systems based on creativity, knowledge, and entrepreneurial thinking.

Successful models in countries such as the Netherlands, Singapore, Canada, and the United Arab Emirates have proven that combining scientific innovation with entrepreneurship can bring about a radical transformation in food systems by strengthening local production, reducing reliance on imports, and achieving a balance between economic efficiency and environmental sustainability.

However, applying these experiences in developing countries requires more than simply transferring technology. It demands institutional and legislative reforms that encourage investment in agricultural innovation, the provision of flexible financial environments that support entrepreneurial projects in their early

stages, and the establishment of a societal culture that views innovation and entrepreneurship as key developmental values.

In light of this, it can be concluded that achieving sustainable food security in the twenty-first century will only be possible through knowledge- and technology-based entrepreneurship, ensuring the development of a diversified, equitable, and resilient food economy capable of confronting climatic and economic changes.

8. List of references:

1. Betka, A., & Mordjane, S. (2024). Entrepreneurship and rural development: Challenges and perspectives in emerging economies. Journal of Agricultural Economics and Development, 12(2), 20–28.
2. Drucker, P. F. (1985). Innovation and entrepreneurship: Practice and principles. Harper & Row.
3. Food and Agriculture Organization of the United Nations. (2022). The state of food security and nutrition in the world 2022: Repurposing food and agricultural policies to make healthy diets more affordable. FAO.
4. Food and Agriculture Organization of the United Nations. (2023). The state of food and agriculture 2023 Leveraging innovation for sustainable food systems. FAO.
5. Government of Canada. (2023). AgriInnovate and Sustainable Food Systems programs: Supporting innovation and sustainability in agri-food. Agriculture and Agri-Food Canada.
6. Klerkx, L., & Villalobos, P. (2024). Smart agriculture and entrepreneurial innovation: Lessons from the Netherlands and Singapore. Agricultural Systems, 230, 1–10.
7. Shahbaz, M., Ahmed, R., & Johnson, L. (2023). Food entrepreneurship and sustainable innovation: Comparative study of Canada and emerging economies. International Journal of Food System Dynamics, 14(1), 1–10.
8. UAE Ministry of Climate Change and Environment. (2024). Food Tech Valley: National strategy for agri-tech and food security in arid environments. UAE Government Press.
9. World Bank. (2022). Global food security innovation report 2022: Digital transformation in food systems. World Bank Publications.
10. World Bank. (2024). Entrepreneurship for sustainable agri-food systems: Policy insights and case studies. World Bank Publications.
11. UNDP. (2020). Human development report 2020: The next frontier Human development and the Anthropocene. United Nations Development Programme. (UNDP publication site).
12. IFAD. (2019). *Creating opportunities for rural youth: Youth entrepreneurship in agriculture.* International Fund for Agricultural Development. (Available via IFAD publications page; example index link).